Appl. No.	:	10/816,015
Applicant	:	De Man et al.
Filed	:	March 31, 2004
Title	:	Rotational Computed Tomography System and Method
TC/A.U.	:	2637
Examiner	:	Chih Cheng G Kao
Docket No.	:	146389-2
Customer No.	:	2882

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APPEAL BRIEF PURSUANT TO 37 C.F.R. §§ 41.31 AND 41.37

This Appeal Brief is being filed in furtherance to the Notice of Appeal mailed on May 07, 2007, and received by the Patent Office on May 07, 2007.

The Commissioner is authorized to charge the requisite fee of $500.00, and any additional fees which may be necessary to advance prosecution of the present application, to Deposit Account No. 07-0868.

1. REAL PARTY IN INTEREST

The real party in interest is General Electric Company, the Assignee of the above-referenced application by virtue of the Assignment to General Electric Company by Bruno Kristiaan Bernard de Man, Samit Kumar Basu, Peter Michael Edic, William Robert Ross, and Mark Ernest Vermilyea, recorded at reel 015181, frame 0227, and dated March 31, 2004. Accordingly, General Electric Company, as the parent company of the Assignee of the above-referenced application, will be directly affected by the Board's decision in the pending appeal.

2. RELATED APPEALS AND INTERFERENCES

Appellants are unaware of any other appeals or interferences related to this Appeal. The undersigned is Appellants' legal representative in this Appeal.

3. **STATUS OF CLAIMS**

Claims 1, 3-21, 23-33, 35-37, 39-41 and 43-47 are currently pending, are currently under final rejection and, thus, are the subject of this Appeal.

4. **STATUS OF AMENDMENTS**

Claims 37, and 45-47 have been amended to address the informalities as pointed out in the Final Office Action dated February 7, 2007, on Page 2, under the sub-head "Claim Objections". No new matter has been added. Claims 39 and 40 were objected to by virtue of their dependency. Appellants request withdrawal of claim objections in view of the amendments.

5. **SUMMARY OF CLAIMED SUBJECT MATTER**

The present invention relates generally to the field of computed tomography imaging systems. In particular, the invention relates to geometries and configurations for sources and detectors in such systems designed to reduce the rotational load and to enhance speed and imaging abilities of the systems. *See* Application, page 1, paragraph [0002].

The Application contains six independent claims, namely, claims 1, 37, 41, 45, 46, and 47 which are the subject of this Appeal. The subject matter of these claims is summarized below.

With regard to the aspect of the invention set forth in independent claim 1, discussions of the recited features of claim 1 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates an imaging system (e.g. 10) comprising one or more distributed X-ray sources (e.g. 54, 70, 74, 76) substantially surrounding an

imaging volume and configured to generate X-ray radiation towards the imaging volume; one or more detectors (e.g. 52, 68) for receiving the X-ray radiation after attenuation in the imaging volume and processing corresponding signals to produce measurement volumetric data; and a source controller (e.g. 16) for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors, wherein the one or more distributed X-ray sources and/or the one or more detectors are arranged about a scanner aperture such that the one or more distributed X-ray sources rotate around the scanner aperture in relation to the imaging volume during an imaging sequence. *See, e.g.*, *id* paragraph [0020], [0021], FIG. 1, paragraph [0033], FIG. 4 and paragraphs [0035] and [0036], and FIGs. 8-11.

With regard to the aspect of the invention set forth in independent claim 37, discussions of the recited features of claim 37 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates an X-ray imaging system (e.g. 10) for scanning a volume to be imaged, the system comprising one or more distributed X-ray sources (e.g. 54, 70, 74, 76) substantially surrounding an imaging volume and configured to emanate X-ray radiation; a control circuit (e.g. a circuit including the different controllers, 16, 18, 20 and 22) operably coupled to the distributed X-ray sources; one or more detectors (e.g. 52, 68) for receiving the X-ray radiation after attenuation in the imaging volume; a source controller (e.g. 16) for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors; a motor controller (e.g. 22) configured to displace at least one of the one or more distributed X-ray sources, and the one or more detectors; a processing circuit (e.g. 20) operably coupled to the one or more detectors configured to receive a plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and an operator workstation (e.g. 24) operably coupled to the processing circuit configured to display the one or more reconstructed slices, wherein the

one or more distributed X-ray sources (e.g. 54, 70, 74, 76) are arranged about a scanner aperture such that the one or more distributed X-ray sources rotate about a scanner aperture in relation to the imaging volume during an imaging sequence. *See, e.g., id* paragraph [0020]-[0025], FIG. 1, paragraph [0033], FIG. 4 and paragraphs [0035] and [0036], and FIGs. 8-11.

With regard to the aspect of the invention set forth in independent claim 41, discussions of the recited features of claim 41 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates to a method of scanning a volume to be imaged, the method comprising providing one or more distributed X-ray sources (e.g. 54, 70, 74, 76) substantially surrounding an imaging volume for generating X-ray radiation towards the imaging volume; providing one or more detectors (e.g. 52, 68) for receiving the X-ray radiation after attenuation; and providing a source controller (e.g. 16) for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors, wherein generating and receiving the X-ray radiation is accomplished by rotating the one or more distributed X-ray sources about a scanner aperture in relation to the imaging volume during an imaging sequence. *See, e.g., id* paragraph [0020], [0021], FIG. 1; paragraph [0033], FIG. 4 and paragraphs [0035] and [0036], and FIGs. 8-11.

With regard to the aspect of the invention set forth in independent claim 45, discussions of the recited features of claim 45 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates to an imaging system comprising one or more distributed X-ray sources (e.g. 54, 60, 64) substantially surrounding an imaging volume and configured to generate X-ray radiation towards the imaging volume, wherein the one or more distributed X-ray sources comprise at least one stationary distributed source (e.g. 54) positioned about a scanner aperture; one or more detectors (52) for

receiving the X-ray radiation after attenuation in the imaging volume and processing corresponding signals to produce measurement volumetric data, wherein the one or more detectors comprises at least one distributed detector configured to rotate around the scanner aperture.; and a source controller (e.g. 16) for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors. *See, e.g., id* paragraph [0020], [0021], FIG. 1; paragraph [0029], [0030], FIG. 3, paragraph [0034], FIG. 5-7.

With regard to the aspect of the invention set forth in independent claim 46, discussions of the recited features of claim 46 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates to an X-ray imaging system for scanning a volume to be imaged, the system comprising one or more distributed X-ray sources (e.g. 54, 60, 64) substantially surrounding an imaging volume and configured to emanate an X-ray radiation, wherein the one or more distributed X-ray sources comprises at least one stationary distributed source (e.g. 54) positioned about a scanner aperture; a control circuit (e.g. 16) operably coupled to the distributed X-ray sources; one or more detectors (e.g. 52) for receiving the X-ray radiation after attenuation in the imaging volume, wherein the one or more detectors comprise at least one distributed detector configured to rotate around the scanner aperture; a source controller (e.g. 16) for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors; a motor controller (e.g. 22) configured to displace at least one of the distributed X-ray sources, and the detectors; a processing circuit (e.g. 50) operably coupled to the detectors configured to receive the plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and an operator workstation operably coupled to the processing circuit configured to display the one or more reconstructed slices. *See, e.g., id* paragraph [0020]-[0025], FIG. 1; paragraph [0029], [0030], FIG. 3, paragraph [0034], FIG. 5-7.

With regard to the aspect of the invention set forth in independent claim 47, discussions of the recited features of claim 47 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates to a method of scanning a volume to be imaged, the method comprising providing at least one stationary distributed X-ray source (e.g. 54, 60, 64) positioned substantially surrounding an imaging volume for generating X-ray radiation towards the imaging volume; providing at least one distributed detector (e.g. 52) configured to rotate around a scanner aperture and configured for receiving the X-ray radiation after attenuation; and providing a source controller (e.g. 16) for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors. *See, e.g., id* paragraph [0020], [0021], FIG. 1; paragraph [0029], [0030], FIG. 3, paragraph [0034], FIG. 5-7.

Benefits of the invention, as recited in these claims, are highlighted in paragraph [0031] and paragraph [0032].

> As will be appreciated by those skilled in the art, reconstruction techniques in CT systems vary in their use of acquired data, and in their techniques and assumptions for image reconstruction. It has been found, in the present technique, that a number of geometries are available for high-speed and efficient operation of a CT system, which provide excellent mathematical completeness of measured data for accurate image reconstruction while significantly reducing the rotational load on the CT scanner, particularly on the gantry and support structures. Figs. 4-11 illustrate exemplary geometries and configurations for distributed sources and for detectors, certain of which are stationary in the CT scanner, but that can be used with conventional or improved image processing and image reconstruction algorithms.
>
> As noted above, enhancement the present CT system configurations is attained by reduction of the rotational load on the system. In particular, presently contemplated embodiments employing distributed X-ray sources and ring or partial ring detectors are

illustrated in Figs. 4 through 11. In general, the arrangements are based upon certain preferred source and detector configurations. By way of example, a distributed source may include a plurality of independently addressable emitters arranged in an array extending at least partially around the circumference of the imaging volume and extending along the Z-axis (generally perpendicular to the imaging plane). Other source configurations may include lines of emitters along the Z- direction, arcuate sources having a plurality of emitters in a row extending around a portion of the circumference of the scanner, and complete ring sources extending substantially completely around the arcuate of the scanner. Detector configurations may be somewhat similar. That is, presently contemplated detector configurations for the improved CT system geometries may be generally similar to existing detectors in construction, but extend around a portion of the scanner aperture or completely around the aperture in a ring-like arrangement. In the description that follows, a ring source or ring detector refers to either a one-dimensional or two-dimensional array of source or detector elements, respectively, centered about some possibly arbitrary axis.

This is a clear difference and distinction from the prior art, as discussed below.

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

First Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's first ground of rejection in which the Examiner rejected claims 45 and 47 under 35 USC 102(e) as being anticipated by Zhou et al. US 2004/0213378 (hereinafter "Zhou 378").

Second Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's second ground of rejection in which the Examiner rejected claims 1, 5, 8-10, 12, 14, 15, 17, 18, 23-27, 29, 30, 35, 36, 41, 43, and 44 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning US 6504892 (hereinafter "Ning").

Third Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's third ground of rejection in which the Examiner rejected claims 3, 4, 6, 7, 11, 16, 19-21, 28, and 31-33 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning and further in view of Zhou et al. US 2002/0094064 (hereinafter "Zhou 064").

Fourth Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's fourth ground of rejection in which the Examiner rejected claim 13 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning and further in view of Price et al. US 2002/0085674 (hereinafter "Price").

Fifth Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's fifth ground of rejection in which the Examiner rejected claims 37, 39, 40, and 46 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning and Hsieh et al. US 5225980 (hereinafter "Hsieh")

7. ARGUMENT

As discussed in detail below, the Examiner has improperly rejected the pending claims. Further, the Examiner has misapplied long-standing and binding legal precedents and principles in rejecting the claims under Sections 102 and 103. Accordingly,

Appellants respectfully request full and favorable consideration by the Board, as Appellants strongly believe that claims 1, 3-37, 39-41, 43-47 are currently in condition for allowance.

A. **Ground of Rejection No. 1:**

Examiner rejected independent claims 45 and 47 under 35 USC 102(e) as being anticipated by Zhou 378. The independent claims 45 and 47 will be discussed separately below. Appellants respectfully traverse this rejection.

1. **Judicial precedent has clearly established a legal standard for a *prima facie* anticipation rejection.**

Anticipation under Section 102 can be found only if a single reference shows exactly what is claimed. *Titanium Metals Corp. v. Banner*, 227 U.S.P.Q. 773 (Fed. Cir. 1985). Thus, for a prior art reference to anticipate under Section 102, every element of the claimed invention must be identically shown in a single reference. *In re Bond*, 15 U.S.P.Q.2d 1566 (Fed. Cir. 1990). Moreover, the prior art reference also must show the *identical* invention "*in as complete detail as contained in the ... claim*" to support a *prima facie* case of anticipation. *Richardson v. Suzuki Motor Co.*, 9 U.S.P.Q. 2d 1913, 1920 (Fed. Cir. 1989) (emphasis added). Accordingly, Appellants need only point to a single element not found in the cited reference to demonstrate that the cited reference fails to anticipate the claimed subject matter.

2. **The Examiner's rejection of independent claims 45 and 47 is improper because the rejection fails to establish a *prima facie* case of anticipation.**

Independent claim 45 recites (with emphasis added):

An imaging system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to generate X-ray radiation towards the imaging volume, wherein the one or more distributed X-ray sources comprise at least one stationary distributed source positioned about a scanner aperture;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume and processing corresponding signals to produce measurement volumetric data, wherein the one or more detectors comprises at least one distributed detector configured to rotate around the scanner aperture.; and

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors.

Independent claim 47 recites (with emphasis added):

A method of scanning a volume to be imaged, the method comprising:

providing at least one stationary distributed X-ray source positioned substantially surrounding an imaging volume for generating X-ray radiation towards the imaging volume;

providing at least one distributed detector configured to rotate around a scanner aperture and configured for receiving the X-ray radiation after attenuation; and

providing a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors.

Zhou 378 describes a CT system with an x-ray source that includes a cathode with multiple individually programmable electron emitting units. *See*, Zhou 378, Abstract. Zhou 378 in FIG. 8 and the related description in paragraph [0071] very clearly discusses only the stationary arrangement of the source and detector. In rejecting independent claims 45 and 47, the Examiner asserted in the Final Office Action dated 7 February 2007 that paragraph 71, lines 8-10 provide a teaching for the claim recitations "wherein the one

or more detectors comprise at least one distributed **detector configured to rotate around the scanner aperture**" as recited in independent claims 45 and 47.

The text from paragraph [0071], lines 8-10 in Zhou states that:

> By controlling each of the x-ray sources individually, multiple slice projections may be produced, **requiring <u>no rotation</u> of the detectors or x-ray source.**

Appellants respectfully submit that the text referred to by the Examiner actually <u>teaches away</u> from the claim recitations since they explicitly state that no rotation of detector or x-ray source is required.

Appellants further state that lines 10-12 of the paragraph [0071] disclose that a **slight (15 degrees or less) rotation** may be incorporated into either the source or the detectors to provide increased radial resolution. However, "slight rotation" for radial resolution purpose cannot be construed as the rotation about the scanner aperture for the purpose of imaging the object. Zhou 378 in FIG. 8 and the related description in paragraph [0071] very clearly discusses only the stationary arrangement of the source and detector.

Thus, Appellants respectfully submit that Zhou 378 does not disclose every element of Appellants' claimed invention and further the stationary arrangement of both source and detector of Zhou 378 teaches away from rotational detectors of Appellants application, and therefore does not anticipate claim 45 or claim 47 of Appellants' application.

B. **<u>Ground of Rejection No. 2</u>:**

Appellants respectfully urge the Board to review and reverse the Examiner's second ground of rejection in which the Examiner rejected claims 1, 5, 8-10, 12, 14, 15, 17, 18,

23-27, 29, 30, 35, 36, 41, 43, and 44 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning. The independent claims 1 and 41 will be discussed separately below. Appellants respectfully traverse this rejection.

1. **Judicial precedent has clearly established a legal standard for a *prima facie* obviousness rejection.**

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (B.P.A.I. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes all of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988).

2. No combination of Zhou 378 with Ning teaches the recitation of independent claims 1 and 41.

Independent claim 1 recites:

> An imaging system comprising:
> one or more distributed X-ray sources substantially surrounding an imaging volume and configured to generate X-ray radiation towards the imaging volume;
> one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume and processing corresponding signals to produce measurement volumetric data; and
> a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors,
> wherein the one or more distributed X-ray sources and/or the one or more detectors are arranged about a scanner aperture such that the **one or more distributed X-ray sources rotate** around the scanner aperture in relation to the imaging volume during an imaging sequence. (emphasis added)

Independent claim 41 recites:

> A method of scanning a volume to be imaged, the method comprising:
> providing one or more distributed X-ray sources substantially surrounding an imaging volume for generating X-ray radiation towards the imaging volume;
> providing one or more detectors for receiving the X-ray radiation after attenuation; and
> providing a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors,
> wherein generating and receiving the X-ray radiation is accomplished by **rotating the one or more distributed X-ray sources about a scanner aperture** in relation to the imaging volume during an imaging sequence. (emphasis added)

Zhou 378 as explained in reference to 102 rejections does not teach rotation of either source or detector. Ning on the other hand relates to a parallel cone beam

reconstruction technique that uses signals along an orbit having a circle plus two or more arcs. *See*, Ning, Abstract and column 3, lines 60-63. As far as imaging apparatus is concerned Ning uses a conventional CT imaging apparatus that uses a source and a detector mounted on a gantry and the entire gantry is rotated. This is clearly illustrated in FIGs 7-12A and also described in column 14, lines 46-51 where Ning states:

> A CBVT CT scanning apparatus examines a body P using a cone shaped radiation beam 704 which traverses a set of paths across the body. As shown in Fig. 7; **an x-ray source 710 and a 2-D detector 711 such as a flat panel detector are mounted on a gantry frame 702 which rotates around the body P** being examined.

Thus Ning clearly discloses the conventional CT imaging system where source and detectors are mounted on a gantry and the gantry is rotated during the imaging procedure. Thus Ning actually teaches away from the completely stationary imaging system of Zhou 378 and does not teach the claim recitations as highlighted above. Ning and Zhou disclose completely distinct imaging systems and techniques that are not complimentary to each other and therefore cannot be combined.

Examiner has asserted that column 4, lines 35-52 provide for a teaching for rotating source. However Ning merely describes a reconstruction techniques in these lines which uses data from the imaging sequence of a circle plus arcs. In the conventional CT system as used by Ning the gantry is rotated in a circle and arc manner, and not the x-ray source. Further Ning does not even disclose a distributed source or a distributed detector as described in claims 1 and 41. The source in Ning is a cone beam source and the detector is a flat panel detector. See, id, column 14, lines 46-55).

Examiner has further referred to column 3, lines 45-49 in Ning as a motivation for combining it with Zhou 378. The referred text merely describes the need for better reconstruction technique. There is absolutely no teaching or motivation in Ning that would render it combinable with the stationary system of Zhou 378. On skilled in the art

will immediately recognize that the imaging techniques and the imaging apparatus in Ning is distinct from Zhou 378 and both are not combinable. If Zhou 378 was to use the imaging apparatus of Ning, then the entire objective of Zhou 378 to reduce the rotational components (see, Zhou 378, paragraph [0010] would be completely negated.

Thus no combination of Zhou 378 with Ning seems possible and no combination yields the Appellants invention as recited in claims 1 and 41, specifically the claim recitations as highlighted above.

C. **Ground of Rejection No. 3:**

Appellants respectfully urge the Board to review and reverse the Examiner's third ground of rejection in which the Examiner rejected claims 3, 4, 6, 7, 11, 16, 19-21, 28, and 31-33 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning and further in view of Zhou 064. All the rejected dependent claims depend from the independent claim 1.

1. **No combination of Zhou 378 with Ning and Zhou 064 teaches the recitation of independent claim 1.**

As argued hereinabove, the combination of Zhou 378 and Ning does not render claim 1 unpatentable. Zhou 064 describes a structure to generate x-rays that has a plurality of stationary and individually electrically addressable field emissive electron sources with a substrate composed of a field emissive material, such as carbon nanotubes. Electrically switching the field emissive electron sources at a predetermined frequency field emits electrons in a programmable sequence toward an incidence point on a target. (*See*, Zhou 064, Abstract). Zhou 064 does not obviate the deficiencies of Zhou 378 or Ning with respect to distributed **source rotation**, and therefore no combination of Zhou 378 , Ning and Zhou 064 leads to Appellants' invention as recited in independent claim 1.

Further, Examiner has referred to Zhou 064 as a teaching for two-dimensional arrays in the distributed sources as claimed in the dependent claims. However, Appellants respectfully submit that Fig. 4, element 404, as indicated by the Examiner does not teach two-dimensional source arrays. Element 404 is a target structure, thus merely a component of the x-ray source and cannot be construed as a two-dimensional array of source elements as recited in dependent claims.

D. **Ground of Rejection No. 4:**

Appellants respectfully urge the Board to review and reverse the Examiner's fourth ground of rejection in which the Examiner rejected claim 13 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning and further in view of Price. Claim 13 depends from independent claim 1.

1. **No combination of Zhou 378 with Ning and Price teaches the recitation of independent claim 1.**

As argued hereinabove, the combination of Zhou 378 and Ning does not render claim 1 unpatentable. Price does not overcome the deficiencies of Zhou 378 and Ning. Price describes a radiography system that has a solid state x-ray source that includes a substrate with a cathode disposed thereon within a vacuum chamber. An anode is spaced apart from cathode within vacuum chamber. *See*, Price, Abstract. Price, in fact, describes a completely stationary source arrangement. Price clearly states in paragraph [0006]:

> Accordingly, it would be desirable to provide a CT scanner and CT scanner system that provides a x-ray source that reduces the complexity of the scanning system and **does not require a rotating x-ray source.**

Appellants' claim 1 specifically recites "**one or more distributed X-ray sources rotate**", thus Price actually teaches away from claim 1 recitations and no combination of Price with Zhou 378 or Ning discloses, teaches or suggests this specific recitation. Therefore, irrespective of what Price teaches or does not teach with reference to dependent claim 13, independent claim 1 is still patentable over the applied references, and therefore claim 13, by virtue of its dependency from an allowable base claim, stands allowable.

E. Ground of Rejection No. 5:

Appellants respectfully urge the Board to review and reverse the Examiner's fifth ground of rejection in which the Examiner rejected claims 37, 39, 40, and 46 under 35 USC 103 (a) as being unpatentable over Zhou 378 in view of Ning and Hsieh. Claims 39 and 40 depend from independent claim 37. The independent claims 37 and 46 will be discussed separately below. Appellants respectfully traverse this rejection.

1. No combination of Zhou 378 with Ning and Hsieh teaches the recitation of independent claim 37 and 46.

Independent claim 37 recites:

> An X-ray imaging system for scanning a volume to be imaged, the system comprising:
>
> one or more distributed X-ray sources substantially surrounding an imaging volume and configured to emanate X-ray radiation;
> a control circuit operably coupled to the distributed X-ray sources;
> one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume;

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors;

a motor controller configured to displace at least one of the one or more distributed X-ray sources, and the one or more detectors;

a processing circuit operably coupled to the one or more detectors configured to receive a plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and

an operator workstation operably coupled to the processing circuit configured to display the one or more reconstructed slices,

wherein the one or more distributed X-ray sources are arranged about a scanner aperture such that one or more distributed **X-ray sources rotate about a scanner aperture** in relation to the imaging volume during an imaging sequence. (emphasis added)

Independent claim 46 recites:

An X-ray imaging system for scanning a volume to be imaged, the system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to emanate an X-ray radiation, wherein the one or more distributed X-ray sources comprises at least one stationary distributed source positioned about a scanner aperture;

a control circuit operably coupled to the distributed X-ray sources;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume, wherein the one or more detectors comprise at least one distributed **detector configured to rotate around the scanner aperture**;

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors;

> a motor controller configured to displace at least one of the distributed X-ray sources, and the detectors;
>
> a processing circuit operably coupled to the detectors configured to receive the plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and
>
> an operator workstation operably coupled to the processing circuit configured to display the one or more reconstructed slices. (emphasis added)

As argued hereinabove, the combination of Zhou 378 and Ning does not render claim 1 unpatentable. Hsieh does not overcome the deficiencies of Zhou 378 or Ning. Hsieh merely describes an apparatus for reducing image artifacts caused by over-ranging or clipping of the data collected in tomographic scan. *See*, Hsieh, Abstract. Irrespective of what Hsieh teaches or does not teach with respect to the dependent claims, it still, either alone or in combination with Zhou 378 and/or Ning does not teach the above highlighted recitations of claim 37 and 46. Therefore the applied references do not render independent claims 37 and 46 unpatenatable. The dependent claims 39 and 40 are therefore similarly allowable.

Conclusion

Appellants respectfully submit that all pending claims are in condition for allowance. However, if the Examiner or Board wishes to resolve any other issues by way of a telephone conference, the Examiner or Board is kindly invited to contact the undersigned attorney at the telephone number indicated below.

Respectfully submitted,

Date: July 9, 2007

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8. APPENDIX OF CLAIMS ON APPEAL

Listing of Claims:

1. (previously presented) An imaging system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to generate X-ray radiation towards the imaging volume;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume and processing corresponding signals to produce measurement volumetric data; and

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors,

wherein the one or more distributed X-ray sources and/or the one or more detectors are arranged about a scanner aperture such that the one or more distributed X-ray sources rotate around the scanner aperture in relation to the imaging volume during an imaging sequence.

2. (cancel)

3. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise one or more two-dimensional arrays of source elements extending substantially around the aperture.

4. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise one or more two-dimensional arrays of source elements extending around a portion of the aperture.

5. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise one or more one-dimensional arrays of source elements extending substantially around the aperture.

6. (original) The imaging system of claim 5 further comprising:

one one-dimensional array of source elements extending substantially around the aperture; and

one or more line sources.

7. (original) The imaging system of claim 5 further comprising:

two or more one-dimensional arrays of source elements extending substantially around the aperture; and

one or more line sources.

8. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise one or more one-dimensional arrays of source elements extending around a portion of the aperture.

9. (previously presented) The imaging system of claim 1 wherein the one or more detectors comprise one or more two-dimensional arrays of detector elements extending around at least a portion of the aperture.

10. (previously presented) The imaging system of claim 1 wherein the one or more detectors comprise one or more one-dimensional arrays of detector elements extending around at least a portion of the aperture.

11. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise one or more line sources.

12. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise a plurality of independently addressable source elements arranged in one or more arrays.

13. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise:

a cold cathode emitter housed in a vacuum housing; and,

a stationary anode disposed in a vacuum housing and spaced apart from the cold cathode emitter.

14. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise addressable emission devices and the emission devices comprise thermionic emitters, cold-cathode emitters, carbon-based emitters, photo emitters, ferroelectric emitters, laser diodes, or monolithic semiconductors.

15. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise at least one distributed source configured to rotate around the scanner aperture and the one or more detectors comprise at least one stationary and distributed detector positioned about the scanner aperture.

16. (original) The imaging system of claim 15 wherein the at least one distributed source includes one or more two-dimensional arrays of source elements.

17. (original) The imaging system of claim 15 wherein the at least one distributed source includes one or more one-dimensional arrays of source elements.

18. (previously presented) The imaging system of claim 17 wherein the one or more one-dimensional arrays of source elements extend around at least a portion of the aperture.

19. (original) The imaging system of claim 18 further comprising a one-dimensional array of source elements extending around at least a portion of the aperture, and one or more line sources.

20. (original) The imaging system of claim 18 further comprising two or more one-dimensional arrays of source elements extending around at least a portion of the aperture and one or more line sources.

21. (previously presented) The imaging system of claim 17 wherein the at least one of the one or more one-dimensional arrays of source elements includes at least one line source extending at least along a Z-direction.

22. (previously presented) The imaging system of claim 21, wherein the at least one line source comprises a target configured as a hollow cylinder rotating around an axis of the hollow cylinder.

23. (original) The imaging system of claim 15 wherein the at least one stationary and distributed detector includes one or more two-dimensional arrays of detector elements extending substantially around the aperture.

24. (original) The imaging system of claim 15 wherein the at least one stationary and distributed detector includes one or more two-dimensional arrays of detector elements extending around a portion of the aperture.

25. (original) The imaging system of claim 15 wherein the at least one stationary and distributed detector includes one or more one-dimensional arrays of detector elements extending substantially around the aperture.

26. (original) The imaging system of claim 15 wherein the at least one stationary and distributed detector includes one or more one-dimensional arrays of detector elements extending around a portion of the aperture.

27. (previously presented) The imaging system of claim 1 wherein the one or more distributed X-ray sources comprise at least one distributed source configured to rotate around the scanner aperture and the one or more detectors comprise at least one distributed detector configured to rotate around a scanner aperture.

28. (original) The imaging system of claim 27 wherein the at least one distributed source includes one or more two-dimensional arrays of source elements.

29. (original) The imaging system of claim 27 wherein the at least one distributed source includes one or more one-dimensional arrays of source elements.

30. (previously presented) The imaging system of claim 29 wherein the one or more one-dimensional arrays of source elements extend around at least a portion of the aperture.

31. (original) The system of claim 30 further comprising a one-dimensional array of source elements and one or more line sources.

32. (original) The system of claim 30 further comprising two or more one-dimensional arrays of source elements and one or more line sources.

33. (previously presented) The imaging system of claim 29 wherein at least one of the one or more one-dimensional arrays of source elements includes at least one line source extending at least along a Z-direction.

34. (previously amended) The imaging system of claim 33, wherein the at least one line source comprises a target configured as a hollow cylinder rotating around an axis of the hollow cylinder.

35. (original) The imaging system of claim 27 wherein the at least one distributed detector includes one or more two-dimensional arrays of detector elements extending around at least a portion of the aperture.

36. (original) The imaging system of claim 27 wherein the at least one distributed detector includes one or more one-dimensional arrays of detector elements extending around at least a portion of the aperture.

37. (currently amended) An X-ray imaging system for scanning a volume to be imaged, the system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to emanate X-ray radiation;

a control circuit operably coupled to the one or more distributed X-ray sources;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume;

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors;

a motor controller configured to displace at least one of the one or more distributed X-ray sources~~,~~ and the one or more detectors;

a processing circuit operably coupled to the one or more detectors configured to receive a plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and

an operator workstation operably coupled to the processing circuit configured to display the one or more reconstructed slices,

wherein the one or more distributed X-ray sources are arranged about a scanner aperture such that the one or more distributed X-ray sources rotate about a scanner aperture in relation to the imaging volume during an imaging sequence.

38. (cancel)

39. (previously presented) The X-ray imaging system of claim 37 wherein the one or more distributed X-ray sources comprise at least one distributed source configured to rotate around the scanner aperture and the one or more detectors comprise at least one distributed detector configured to rotate around a scanner aperture.

40. (previously presented) The X-ray imaging system of claim 37 wherein the one or more distributed X-ray sources comprise at least one distributed source configured to rotate around the scanner aperture and the one or more detectors comprise at least one stationary and distributed detector positioned about the scanner aperture.

41. (previously presented) A method of scanning a volume to be imaged, the method comprising:

providing one or more distributed X-ray sources substantially surrounding an imaging volume for generating X-ray radiation towards the imaging volume;

providing one or more detectors for receiving the X-ray radiation after attenuation; and

providing a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors,

wherein generating and receiving the X-ray radiation is accomplished by rotating the one or more distributed X-ray sources about a scanner aperture in relation to the imaging volume during an imaging sequence.

42. (cancel)

43. (original) The method of claim 41 wherein providing the one or more distributed X-ray sources comprises providing at least one distributed source configured to rotate around the scanner aperture and providing the one or more detectors comprises providing at least one distributed detector configured to rotate around a scanner aperture.

44. (original) The method of claim 41 wherein providing the one or more distributed X-ray sources comprises providing at least one distributed source configured to rotate around the scanner aperture and providing the one or more detectors comprises providing at least one stationary and distributed detector positioned about the scanner aperture.

45. (currently amended) An imaging system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to generate X-ray radiation towards the imaging volume, wherein the one or more distributed X-ray sources comprise at least one stationary distributed source positioned about a scanner aperture;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume and processing corresponding signals to produce measurement volumetric data, wherein the one or more detectors comprise ~~comprises~~ at least one distributed detector configured to rotate around the scanner aperture~~.~~; and

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors.

46. (currently amended) An X-ray imaging system for scanning a volume to be imaged, the system comprising:

one or more distributed X-ray sources substantially surrounding an imaging volume and configured to emanate ~~an~~ X-ray radiation, wherein the one or more

distributed X-ray sources comprise ~~comprises~~ at least one stationary distributed source positioned about a scanner aperture;

a control circuit operably coupled to the distributed X-ray sources;

one or more detectors for receiving the X-ray radiation after attenuation in the imaging volume, wherein the one or more detectors comprise at least one distributed detector configured to rotate around the scanner aperture~~.~~;

a source controller for triggering one or more emitters in the one or more distributed X-ray sources at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the one or more detectors;

a motor controller configured to displace at least one of the one or more distributed X-ray sources~~,~~ and the one or more detectors;

a processing circuit operably coupled to the one or more detectors configured to receive a ~~the~~ plurality of projection images and to form one or more reconstructed slices representative of the volume being imaged; and

an operator workstation operably coupled to the processing circuit configured to display the one or more reconstructed slices.

47. (currently amended) A method of scanning a volume to be imaged, the method comprising:

providing at least one stationary distributed X-ray source positioned substantially surrounding an imaging volume for generating X-ray radiation towards the imaging volume;

providing at least one distributed detector configured to rotate around a scanner aperture and configured for receiving the X-ray radiation after attenuation; and

providing a source controller for triggering one or more emitters in the at least one stationary ~~one or more~~ distributed X-ray source ~~sources~~ at each instant in time of an image acquisition for creating multiple projections for acquiring volumetric data by the at least one distributed detector ~~one or more detectors~~.

9. <u>APPENDIX OF EVIDENCE</u>

None.

10. **APPENDIX OF RELATED PROCEEDINGS**

None.